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Soft – Switched PFC Boost Converter with Integrated Flyback Converter

S.Kamalsakthi, J.Baskaran

Abstract- ***This paper presents a magnetic integration approach that reduces the number of magnetic components in a power supply by integrating magnetic components in two conversion stages. In this proposed approach a single transformer is used to implement the continuous conduction mode boost power factor corrected(PFC)converter and the DC/DC fly-back converter. The power factor is improved due to the presence of the boost converter. The size of the step-down transformer is reduced due to high frequency operation of fly-back converter. The AC supply is rectified using uncontrolled rectifier and it is boosted with the help of boost converter. The output of the boost converter is given to the fly-back converter, which converts DC to high frequency AC. The step-down transformer reduces this voltage and is rectified using half wave rectifier.***

Keywords- ***DC/DC, AC, (PFC)***

I. INTRODUCTION

The majority of today's AC/DC power supplies used in modern data processing and telecom equipment have a boost power factor corrected (PFC) front end and is low power stand-by-power supply. The front-end boost rectifier is employed to reduce the line current harmonics and to provide compliance with various world wide specifications governing the harmonic limits of the line current in ac/dc power supplies. The main purpose of stand-by power is to provide housekeeping power and to ensure system.

Functionality when system is in power mode. The majority of stand-by powers are implemented with a fly-back converter due to its low parts count and its ability to operate, efficiently in a wide input voltage range.

To meet the challenges of the ever-present requirement to decrease the size of power conversion equipment, power supplies operating at higher switching frequencies is used. A further size reduction can be achieved by minimizing the number of components thro' components integration.

This paper presents a new magnetic integration approach where the reduction number of magnetic components in a power supply is achieved by utilizing the same magnetic in two conversion stages of the power supply. Specifically, in the proposed approach, a single transformer is used to implement the integration of the CCM PFC boost converter and the fly-back converter.

The proposed magnetically integrated boost and fly-back converters feature soft switching of all the semi-conductor switches.

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The boost switch and the primary sid fly back converter switch are turned on at zero voltage, whereas the active snubber switch of the boost converter turns off at zero current. In addition, the boost rectifier is turned off softly with a controlled di/dt rate so theat the reverse-recovery-related losses of the boost rectifier are virtually eliminated

II. APPLICATIONS

- Telecom equipment.
- Fractional HP servo motors.
- Relays.
- CMOS Chips.

III. CIRCUIT DESCRIPTION

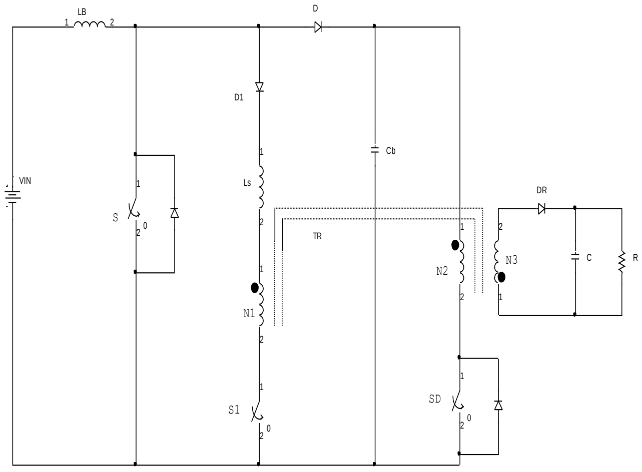

Fig:1 Circuit Diagram of PFC boost rectifier with integrated fly-back converter

The circuit diagram of the proposed soft- switched boost converter magnetically integrated with a dc/dc fly-back converter is shown in Fig.. The boost converter consists of voltage source V_{IN} , boost inductor L_B , main switch S, boost rectifier D, energy storage capacitor C_B, and the active snubber circuit formed by auxiliary switch S_1, winding N_1 of transformer TR, snubber inductor L_S and blocking diodeD_1. The dc/dc fly-back converter consist of switch S_D with an associated anti parallel diode, isolation transformer TR , and the secondary side circuit that consists of rectifier D_R and output capacitor C_f. To facilitate the circuit operation, the energy storage capacitor can be modeled as a voltage sourceV_B by assuming that the value of C_B is large so that the voltage ripple across the capacitor is small in comparison to its dc voltage. In addition, boost inductor L_B is modeled as constant current source I_{IN} by assuming that the inductance of L_B is large so that during a switching cycle the current through L_B does not change significantly.

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To simplify the control circuit timing diagram, the turn on of switch S_D is synchronized with the turn on of boost switch S. The auxiliary switch S_1 is turned on prior to turn on of switches S and S_D. In addition, auxiliary switch S_1 is turned off before S or S_D is turned off i.e., the proposed circuit operates with overlapping gate drive signals for the active snubber switch and the converter switches.

IV. MODES OF OPERATION

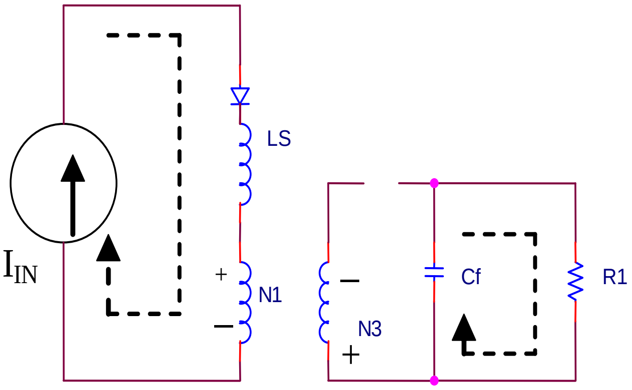

Fig:2 Mode 1

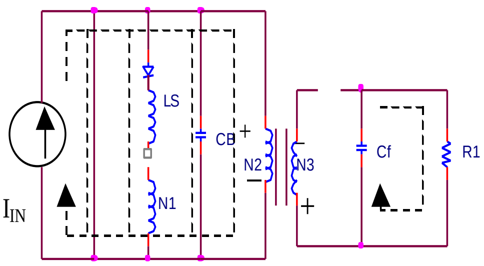

Fig : 3 Mode 2

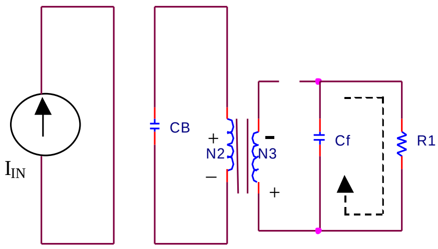

Fig : 4 Mode 3

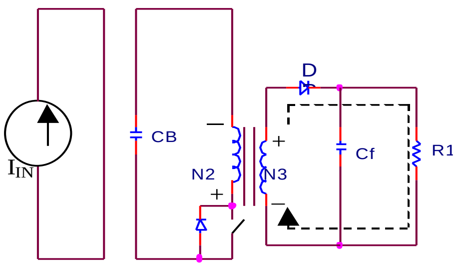

Fig : 5 Mode 4

In mode1,switch S1 is on as shown in fig (a), The entire input energy is transferred to the snubber inductor Ls and the current though the snubber inductor Ls increases.

In mode2 switch S1, S and SD on as shown in fig(b), The input current flows through switch S. The current through the snubber inductor Ls decreases linearly until it reaches zero. Now, the auxillary switch S1 is turned to achieve ZCS. The rectifier diode DR is reverse biased and does not conduct.

In mode3, S1 and SD are on as shown in fig(c), Since switch S1 is turned off, the entire input current flows though the boost switch S. As a result, the front-end boost coverter stage is completely dc coupled from the fly-back converter stage.

In mode4 switch SD is turned off and switch S1 continues to conduct as shown in fig6. As a result the polarity of the transformer winding N2 reverses and the diode Dr starts to conduct Specifically, the boost switch S and the fly-back converter switch SD are turned on at ZVS, whereas auxillary switch S1 is turned off at ZCS. In addition, boost diode D is turned off with a controlled turn-off rate of its current. Because all semiconductor components of the proposed converter operates with soft switching, the overall switching loses are minimized, which maximizes the conversion efficiency. In addition, soft switching has a beneficial effect on EMI and may result in a smaller size input filter.

V. SIMULATION CIRCUIT DIAGRAM

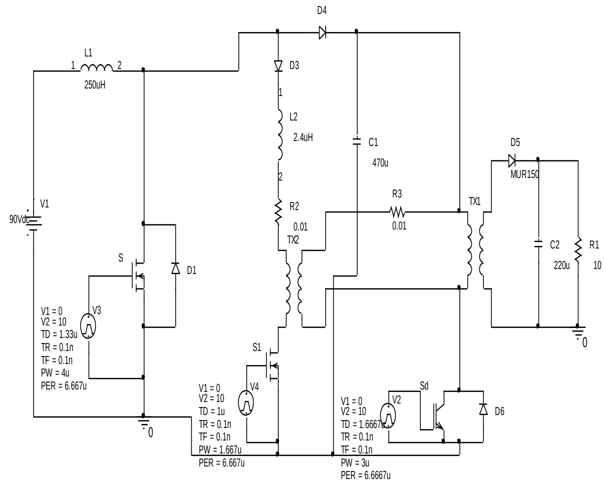

Fig : 6 A New Soft – Switched PFC boost Rectifier with Fly back converter

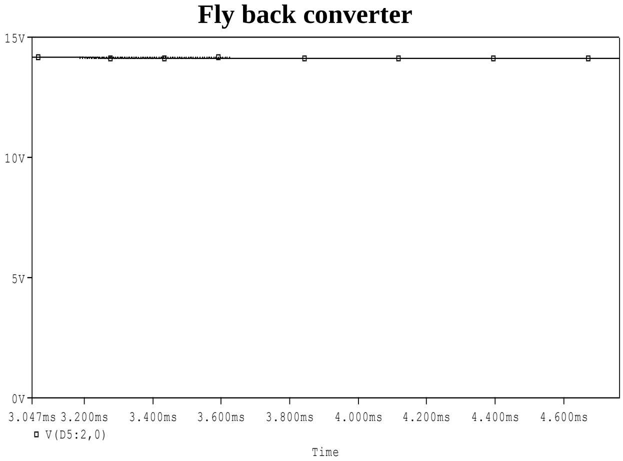

Fig :7 Output voltage

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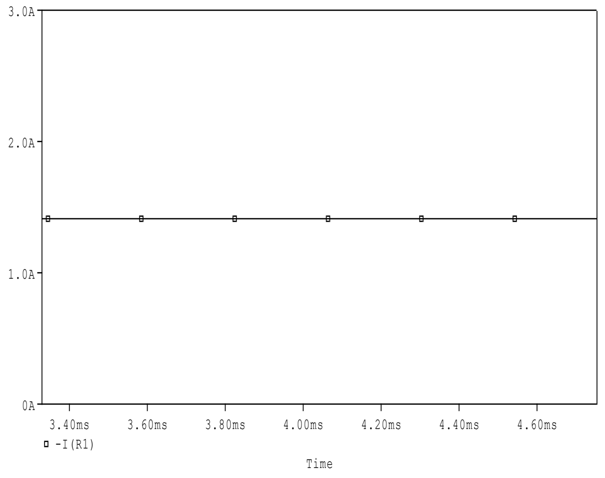

Fig : 8 Output current

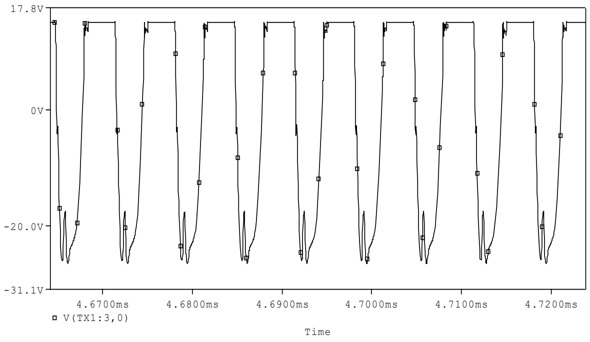

Fig :9 Transformer secondary side voltage

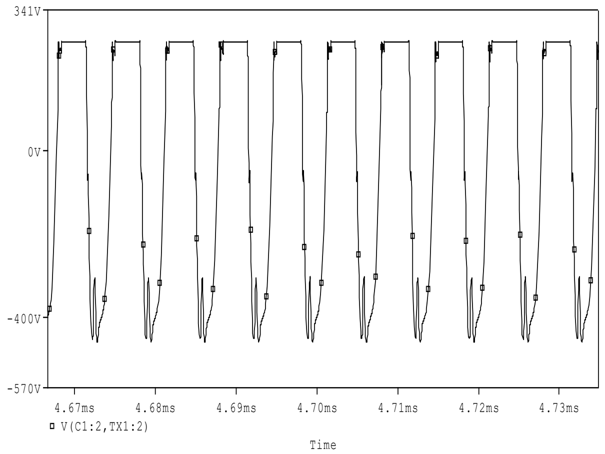

Fig : 10 Transformer primary side voltage

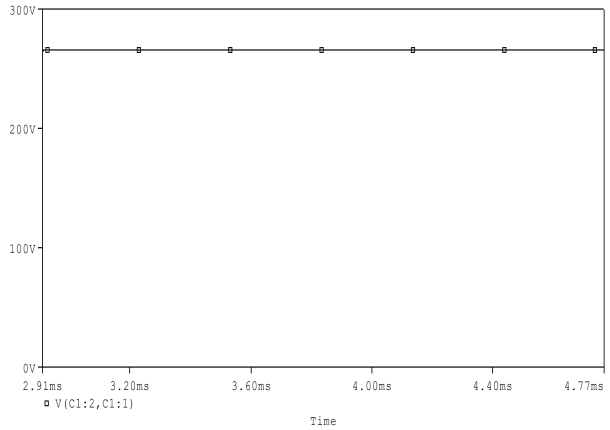

Fig :11 Boost voltage

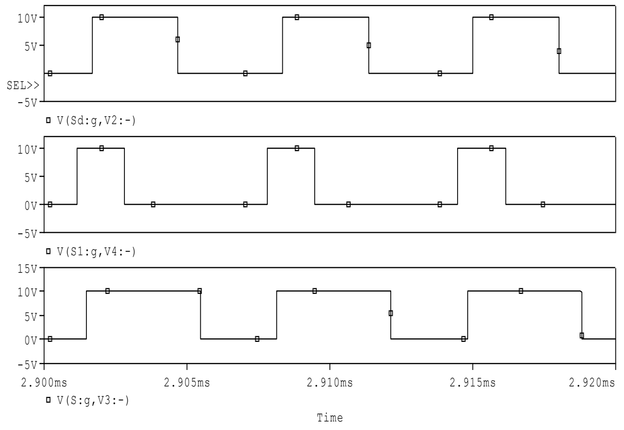

Fig :12 Triggering pulses for switches S, S1, Sd

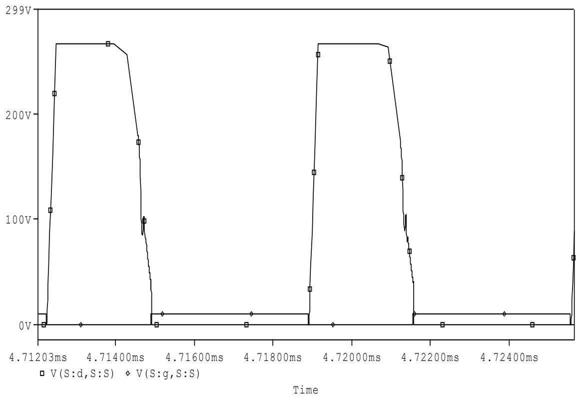

Fig :13 V_{ds} and V_{gs}

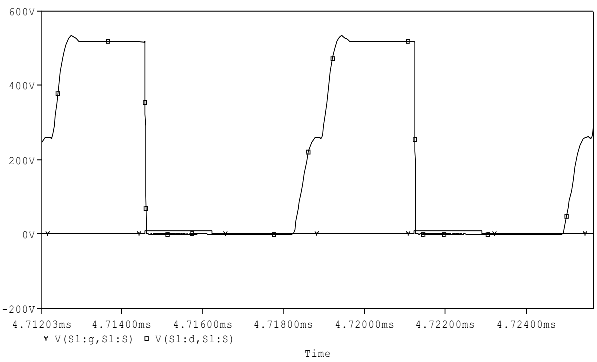

Fig: 14 V_{gs1} and V_{ds1}

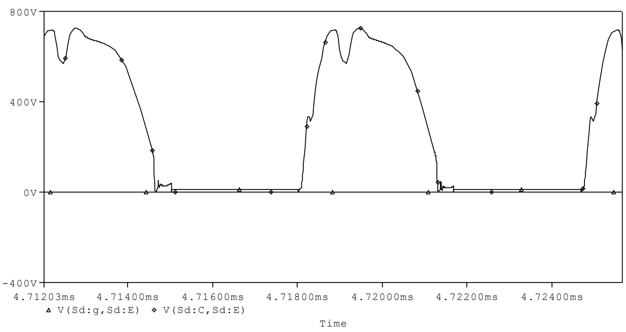

Fig: 15 V_{gs} and V_{ds}

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VI. CONCLUSION

A new PFC boost converter with an integrated stand-by fly-back converter that c an achieve soft-switching of all semiconductor devices in the power stages has been introduced. By using a single magnetic device which is mutually shared by the PFC boost converter and the stand-by fly back converter, boost switch S and flyback switch Sd are turned on with ZVS, auxillary switch S1 is turned off with ZCS, and boost diode D id turned off softly using a controlled di/dt rate. As a result, the turn-on switching loses in the boost and flyback switches, the turn-off switching loss in the auxillary switch, and reverse revovery-related losses in the boost diode are eliminated, which maximizes the conversion efficiency. The performance of the proposed converter was verified on a 150-khz, 450-W prototype circuit that was designed to operated from a universal ac-line input. The PFC boost coverter and the stand-by fly back converter of the prototype circuit deliver upto 1.2 A at a 380-V output and 2.2A at a 12-V output, respectively. The proposes technique imporves the efficiency by approximately 5% at 450 W

REFERENCES

1. R.Streit and Tollik. "High efficiency telecim rectifier using a novel soft-switched boost-based input current
2. G Hua, c.slue and f.c.lee- " novel zero-voltage-transmisson PWM Converters." In proc. I EEE power electronics specialties.'conf. (PESC), june 1992,pp.55-61.
3. D.C.Martins, F.J.M.de Seixas.J.Abrilhante, andI. Barbi "A family of de-to-de PWM converters using a new anewZVS Communication cell." In proc. IEEE poer Electronics Specialist'conf (PESC), Jan 1993 pp.524-530.
4. J.p.Gegener and c.Q.Lee " Zero-voltage transition converter using a simple magnetic feedback and technique in proc.IEEE Applied Power electronics (APEC) conf., 1994.pp.590-596
5. www. Powerdesigners. Com
6. www. Powerelectronics.com

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